Asian Journal of Multidisciplinary Studies
Volume 3, Issue 1, January 2015

ISSN: 2321-8819 (Online)
2348-7186 (Print)
Impact Factor: 0.923

Remote Sensing Based Methodology Crop Acreage Estimation at Plot Level of Aliabad Village Barabanki District, Uttar Pradesh, India

Dilip Kumar[1] and P.C.Gupta[2]

[1&2]Soil and Agriculture Resource Division,
Uttar Pradesh Remote Sensing Application Center, Lucknow, India

Abstract: *The study was carried out in village of Aliabad, Barabanki district, Uttar Pradesh demonstrate the potential of high resolution Remote sensing data is produce crop acreage data base at plot level that would facilitate for the very important factors of food security planning. The estimates obtained by analysis of satellite data were compared with agricultural data (conventional data). For this study, detailed plot level crop acreage estimation database was generated by interpreting IRS P6-LISS III data and by undertaking field survey. This database was integrated with cadastral map and was analyzed for preparation of an action plan for the village level. In this paper, we analyses problems that remote sensing technique met in plot level of acreage estimation of LISS-III satellite data. During the stratification procedure, such as limited field checks was considered as well as proportions of main crop types. And then, we first estimate crop proportion using cluster sampling assisted by remotely sensed image. The two rabi and kharif seasons images of Aliabad village was analyzed and compared with agricultural data which showed that by use of remote sensing techniques major crops viz., wheat, paddy, sugarcane and potato can be identified and classified with high accuracy of more than 95% at plot level. The new technology of remote sensing has played vital role in providing timely and reliable information on the natural resources of an area at cadastral level. The Village level crop acreage estimation is a great significance to develop food policies and economic plans for the countries.*

Key Words: Remote Sensing, GIS, GPS, Land use/Land cover, GDP, MSL, GNP, Water Resources.

Introduction:

Agriculture is the backbone of Indian economy, contributing about 40% towards the Gross National Product (GNP) and providing livelihood to about 70% of the population. In India wheat is the important food crop being next to rice and contributes about 37% to the total food grain production in India. Indian economy is said to be agriculture dependent, as more than 30% of GDP (Gross Domestic Production) comes from agriculture sector. Wheat is a dominant rabi crop in northern and central states of India, which include Uttar Pradesh, Punjab, Madhya Pradesh, Rajasthan and Bihar. Wheat is widely distributed in India. Being grown from 150N to 300N, from 720 E to 92o E and from mean sea level (MSL) to fairly high attitudes. Uttar Pradesh ranks first place in India with acreage of 9.23M ha and Production 23.17 M tones.

In view of above scenario authentic and timely information about acreage and production of agriculture crops at plot level are very much important for management of demand and supply. It is essentially for taking important decision with regards to marketing and expert oriented price policy. In principle, high resolution satellite data on a regular basis, used in conjunction with detailed cadastral maps, open up the possibility of deciphering these features even down to particular survey numbers. A project on Crop Acreage and Production Estimation (CAPE) under the Remote Sensing Applications Mission (RSAM) with enlarged scope and objectives was formulated in 1986. A concentrated effort has been made under this programme to develop methodology applicable over large areas (Sahai and Dadhwal, 1990). Remote Sensing (RS) can provide information on important crop growth variables on a regional scale. Vegetation Indices (VIs) derived from RS data acquired at maximum vegetative growth stage are indicative of crop growth, vigour and potential grain yield. Numerous factors including weather parameters and agronomic practices, which vary from area to area affect crop yield in a given region. Over the past decade, a number of crop yield forecasting models using RS data have been developed (ldso et. al., 1980; Dubey et al., 1994; Datta et. al. 1995.; Kalubarme et. al., Urmil Verma et. al. 2003).

The new technology of remote sensing has played vital role in providing timely and reliable information on the natural resource of an area at cadastral level. Remote sensing by new generation satellites with high spatial, spectral and temporal resolution has opened up new dimension in field of crop acreage estimation, which is accurate and can be accomplished in near real time mode.

The need for timely and reliable agricultural information as plot level acreage estimation, livestock inventories and socio-economic data has become more important in decision- making process at international and national level in almost all countries with the global shift towards market economies. Increasing population pressure may

result in food security especially in developing countries. Therefore, reliable crop area estimations are very important factors in food security.

Study area:

The Study area was carried out in village Aliabad, Barabanki district of Uttar Pradesh, India and lies between east longitudes from latitude 81°37'52" E to 26°50'29" N and longitude 81°38'58" E to 26°51'17" N. and covering a total area of 157.75 ha geographical area. The satellite data IRS P6 LISS III path and row is 100-52 falls in Aliabad village (Figure-**1**).

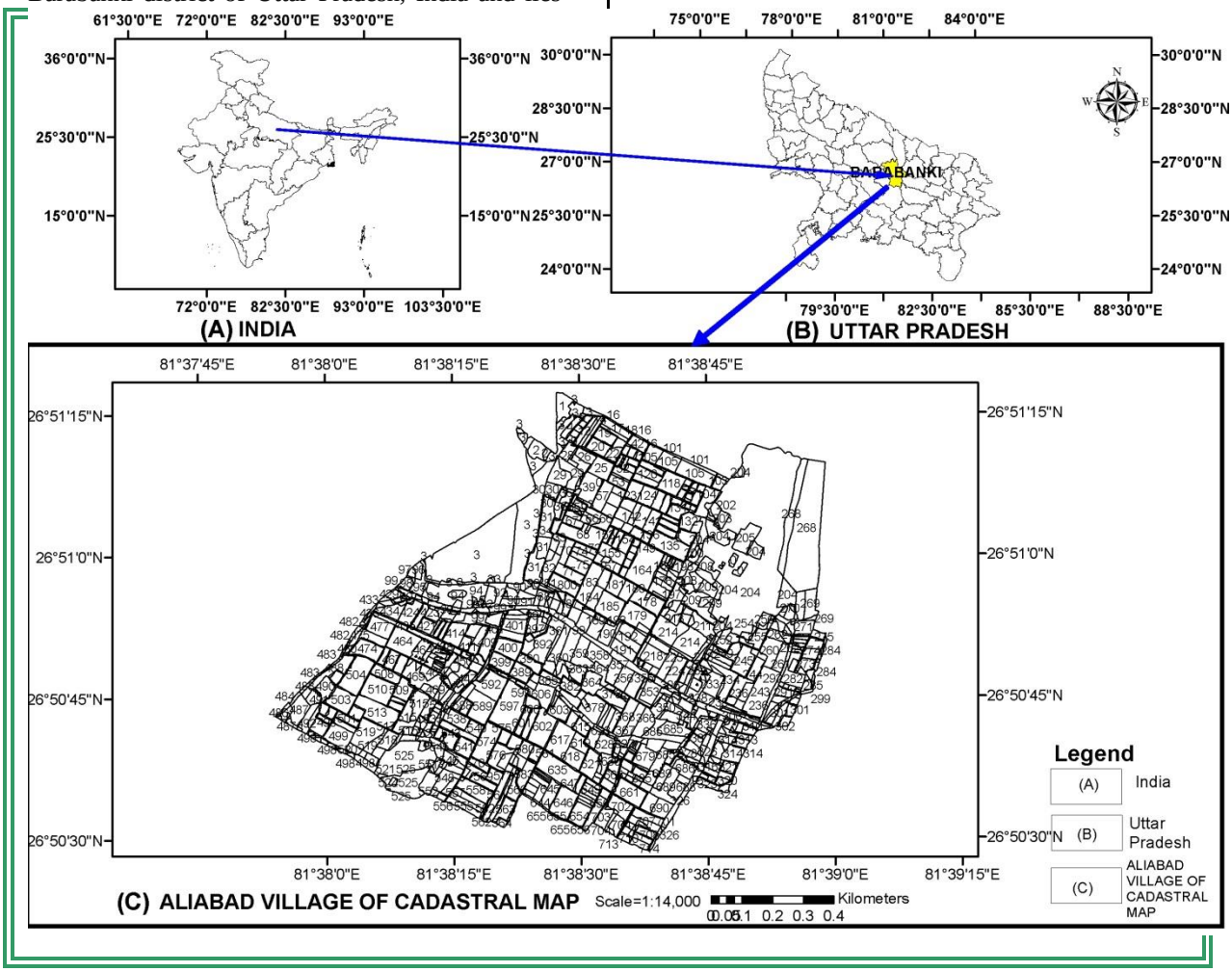

Figure-1: Location map of the Aliabad Village, Barabanki district, Uttar Pradesh.

Data used:

For this study, digital data of Indian Remote Sensing Satellite IRS P6 Linear Imaging Self- scanning Sensor-III of used Rabi and Kharif season. Ancillary data referred include Agricultural data (conventional data) and village map (obtained from Department of Agriculture, Govt. of Uttar Pradesh. G.P.S. Field survey data was also collected during the field study of Rabi and Kharif season. The details of satellite data used for digital analysis are given below:

Table:1 Satellite data used in the study area

Village	**Kharif**		**Rabi**	
----	Data	Date	Data	Date
Aliabad	LISS-III	14.10.2009	LISS-III	07.03.2010
Path/Row	100-52		100-52	

Methodology:

The methodology is essentially digital analysis of IRS-P6 (LISS-III) geo-coded image (FCC) for identification and discrimination of different categories of crops or land use / land cover which is based on tone, texture, shape and size etc. in addition to the local knowledge of analyst. Other

ancillary data like topographical maps and any other available information are used for identification and classification of different crops at cadastral level. The research efforts related to yield models for forecasting needs to be directed towards from the statistical approach to model based approach, which will use crop growth functions as well as model based crop parameter retrieval from satellite data (Dadhwal, 1999). The methodology followed in generation of digital data base of land use / land covers at village level are grouped into following heads.

(A) Registration of cadastral map and Satellite data:

The Survey of India maps were first registered with the vectors of grid base and subsequently the satellite data of two Rabi and Kharif seasons are rectified with respect to Survey of India topographical maps on 1:50,000 scale and these are polyconic projected and finally a village mosaic was prepared using EASI/PACE image processing software. Cadastral maps were also registered and projected on same scale in ARC/INFO.

(B) Supervised Classification of Satellite data :

The supervised classification base on ground truth information was performed using Gaussian maximum likelihood (MXL) algorithm. The classification involves following activities:-

a. Satellite data was examined for various land use / land cover categories. Training sites for different categories of crops or land use/ land cover were identified and marked on the satellite images.

b. Accuracy of classification was checked using some of the ground truth information which was not used as training sets.

c. Classified outputs were checked for its accuracy and the results modified for any discrepancy observed.

(C) Creation of masks:

Masks were created for different cultural features viz. road, river, canal and water bodies. Mask for major Vector data base creation includes Conversion of raster image format to vector data in GIS environment. The raster image of land use / land cover map from EASI/PACE was converted to ARC/ INFO compatible format. Polygon coverage of land use / land cover was prepared. Vector layers of cultural features were also prepared and all the errors were removed.

(D) Overlaying and map finalization:

Single appended coverage from individual line feature coverage was generated having all the line features with respective line attributes. Similarly the annotation coverage was overlaid on the land use / land cover map and saved as a single coverage.

(E) Conversion of raster image format to vector data in GIS Environment:

The raster image of land use / land cover map from Geomatica was converted to ARC/INFO compatible format. Polygon coverage of land use/ land cover map was prepared. Vector layers of cultural features were also prepared and all the errors were removed.

(F) Statistics generation:

The area statistics was generated, using MLR function of X PACE after sieving the classified land use/land cover image with 5 pixels which is equivalent to 0.25 ha. Plot wise intermixing pixels were recoded into different crops accordingly to majority of pixel and they were clipped by the plot boundary eventually at cadastral level different crops area statistics was achieved. Acreage estimates of different crops at cadastral level achieved by analysis of remotely sensed satellite data were compared with data of conventional sources like agriculture departmental crop acreage estimates.

Result and Discussion:

The basic features like roads, settlement, water body, plantation and drainage system were observed quite conspicuously on the IRS P6 LISS-III satellite data. These features along with cadastral map with plot numbers (survey numbers) were captured and its data base was prepared for understanding the resource potential of the village. The study reveals that the large size plot boundaries, road, settlement and water body in the cadastral map of Aliabad village fairly matched with the LISS III image features and better result were obtained optimum time and low cost compared to Agricultural data (conventional data). Agriculture crops estimation study of plot level of Aliabad village have been evaluated for different seasons of (Rabi and Kharif) crops. Remote Sensing and GIS based map integrated at plot level for each crops have been prepared and result are discussed bellow.

Rabi Crop Season:

Aliabad village of the major Rabi season crops is wheat, Sugarcane, Arhar, Rapeseed and Mustard, Peas, Potato and Masoor. Wheat is a major crop of the village. It is grown both as irrigated as well s rainfed. The total agriculture area of the Rabi season crop is 85.51ha. Wheat crop area is 40.44ha, Masoor 9.87 ha, Rapeseed and Mustard 5.54 ha, Potato 3.69 ha, Peas 3.05 ha, Sugarcane 0.59 ha, Arhar0.41 ha and other crops 23.65 ha area obtained.

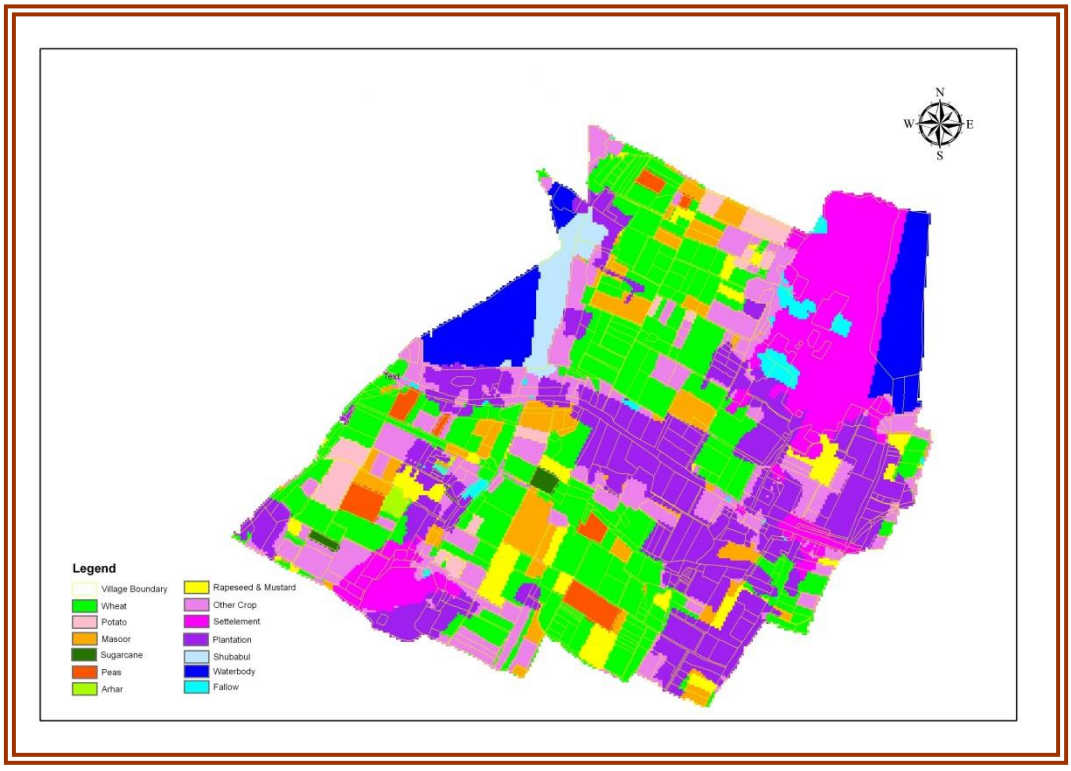

Fig.2- Classified image of Aliabad Village Rabi Season

Field survey information at plot level department of economics and statistics (D.E & S) enumeration Period of rabi season is collaborate with Remote sensing Application Centre, Uttar Pradesh (satellite data on 7.3.2010) analysis given in bellow;

TIMELY REPORT OF AGRICULTURAL STATISTICS SPECIAL ENUMERATION								
LAND USE AREA PARTICULARS								
STATE : U.P.	**DISTRICT:BARABANKI**		**MANDAL:FAIZABAD**				**VILLAGE: ALIABAD**	
SEASON: RABI	**YEAR: 2009-10**	**Area in Hectares**						
Sl. No	As per the Committee classification	Land Classification (D.E & S)	Land Classification (RSAC-U.P.)	D.E & S (Enumeration Period Rabi)	As per RSAC-UP (Satellite data on 7.03.10)	Difference	% of Variation	Remarks
I	Total geographical area			157.05	157.75	-0.70	**0.45**	Unavoidable Human Error
II	Built up area of the village	Houses and constructions	Settlement	34.37	19.70	14.67	59.16	Actual constructed settlement was traced by RS method where is in plot to plot survey entire residential plot area was estimated under Built-up area
III	Area under invariant features	Forest	Forest	-	3.24	-		
		Area Under Non-Agricultural uses Other than Houses and constructions	Area Under Roads, Canal, Tank, stream	–	9.81	-	-	

TIMELY REPORT OF AGRICULTURAL STATISTICS SPECIAL ENUMERATION								
LAND USE AREA PARTICULARS								
STATE : U.P.	**DISTRICT:BARABANKI**		**MANDAL:FAIZABAD**				**VILLAGE: ALIABAD**	
SEASON: RABI	**YEAR: 2009-10**	**Area in Hectares**						
		Barren and Unculturable land	-	-	-	-	-	
		Permanent Pasttures & other grazing lands	-	-	-	-	-	
		Miscellaneous tree crops & groves not included in the net area sown	-	40.04	36.02	-	-	
		Culturable waste	-	-	-	-	-	
		Fallow land other than current fallows		-	-	-	-	
		Current Fallows		-	1.89	-	-	
	Total Non_Agri Area		-	40.04	70.52	30.48	76.13	
IV	**Total Cropped Area**		-	**70.04**	**87.23**	17.19	24.55	

TIMELY REPORT OF AGRICULTURAL STATISTICS SPECIAL ENUMERATION						
CROP WISE AREA PARTICULARS						
DISTRICT:BARABANKI		**MANDAL:FAIZABAD**			**VILLAGE: ALIABAD**	
Sl.No	**Crop Name**	**D.E & S (Enumeration Period Rabi)**	**As per RSAC-UP (Satellite data on 07.03.10)**	**Difference**	**% of Variation**	**Remarks**
1	WHEAT	41.42	40.44	0.98	2.38	
2	PEAS	4.39	3.05	1.332	30.37	Because of peas small Patches and mixed crop
3	SUGARCANE	0.00	0.59	-0.59	_	Classified area under sugarcane was verified in post classification (MXL) ground truth
4	OTHER CROPS	4.94	23.65	-18.71	379.21	Fragmented and small Patches of miner and mixed crop could not we separable in Liss III data
5	POTATO	2.72	3.69	-0.971	35.71	
6	ARHAR	0.00	0.41	-0.41	_	
7	RAPESEED AND MUSTARD	6.26	5.54	0.719	11.49	
8	MASOOR	10.32	9.87	0.454	4.40	
	TOTAL	**70.32**	**85.51**	**-15.19**	**21.60**	

Kahrif Crop Season:

Kharif season crops of the Aliabad village is Paddy, Arhar, Sugarcane and other crops in some part of area not to be identify of LISS III satellite data or plots size is small. Paddy is a major crop of this area. Growing of paddy requires entirely different sets of condition as compared to other crops. The total agriculture area of the Kharif season crops is 85.51ha. Paddy crop area 55.74 ha, Arhar 5.84 ha, Sugarcane 4.85 ha and other crops is 19.8 ha obtained for satellite data.

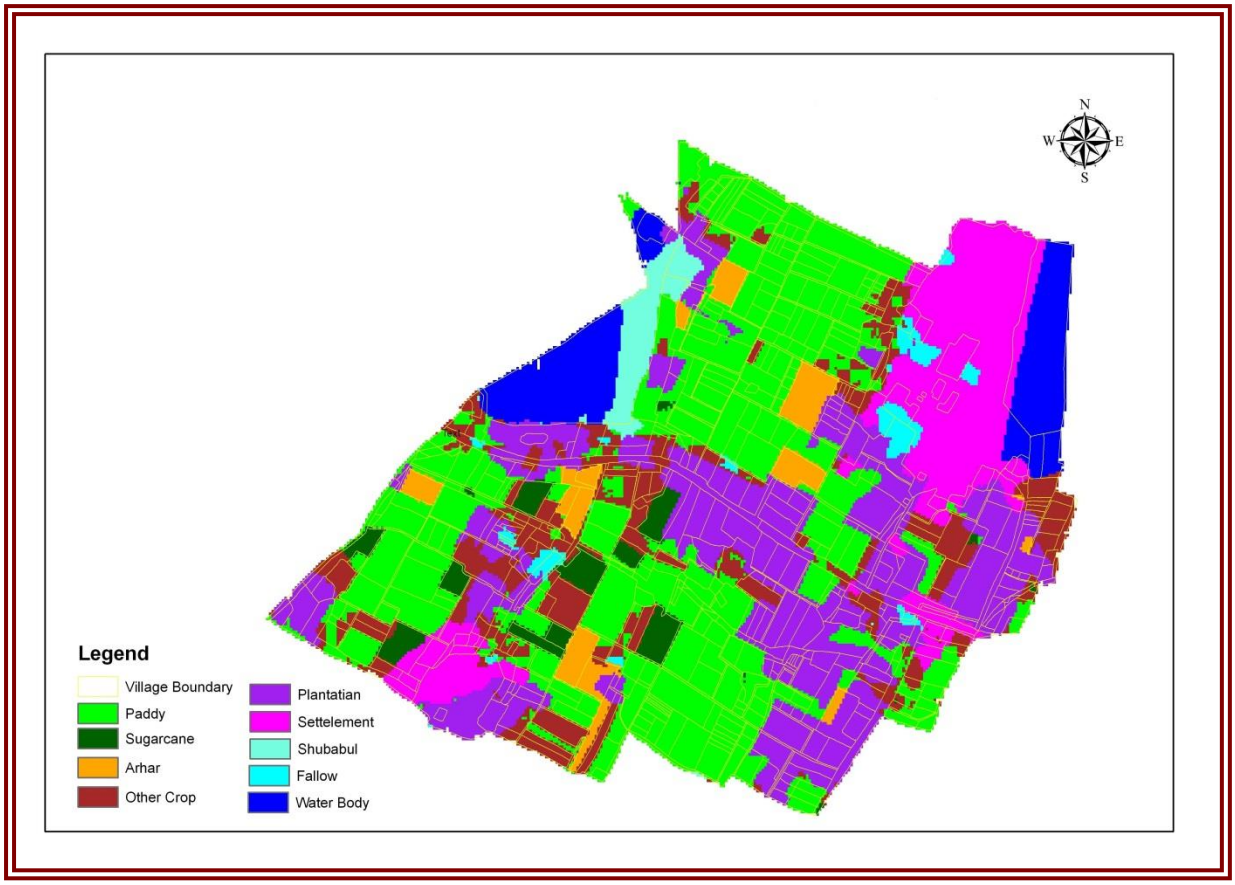

Fig.3- Classified image of Aliabad Village Kharif Season

The field survey information of D.E & S plot level and satellite data analysis of Kharif season is given below:

TIMELY REPORT OF AGRICULTURAL STATISTICS SPECIAL ENUMERATION								
LAND USE AREA PARTICULARS								
STATE : U.P.	**DISTRICT:BARABANKI**		**MANDAL:FAIZABAD**				**VILLAGE: ALIABAD**	
SEASON:KHARIF	**YEAR: 2009-10**	**Area in Hectares**						
Sl.No	**As per the Committee classification**	**Land Classification (D.E & S)**	**Land Classification (RSAC-U.P.)**	**D.E & S (Enumeration Period Kharif)**	**As per RSAC-UP (Satellite data on 14.10.9)**	**Difference**	**% of Variation**	**Remarks**
I	Total geographical area			157.05	**157.75**	**-0.70**	**0.45**	Unavoidable Human Error
II	Built up area of the village	Houses and constructions	Settlement	34.37	19.70	14.67	42.68	Actual constructed settlement was traced by RS method where as in plot to plot survey entire residential plot area was estimated under Built-up area by Agriculture Department

TIMELY REPORT OF AGRICULTURAL STATISTICS SPECIAL ENUMERATION								
LAND USE AREA PARTICULARS								
STATE : U.P.	**DISTRICT:BARABANKI**		**MANDAL:FAIZABAD**				**VILLAGE: ALIABAD**	
SEASON:KHARIF	**YEAR: 2009-10**	**Area in Hectares**						
III	Area under invariant features	Forest	Forest	-	3.243	-	-	
		Area Under Non-Agricultural uses Other than Houses and constructions	Area Under Roads, Canal, Tank, stream	–	10.361	-	-	
		Barren and Unculturable land	-	3.930	-	-	-	
		Permanent Pasttures & other grazing lands	-	-	-	-	-	
		Miscellaneous tree crops & groves not included in the net area sown	-	0.220	36.54	-	-	
		Culturable waste	-	-	-	-	-	
		Fallow land other than current fallows	-	-	-	-	-	
		Current Fallows	-	**2.518**	2.39	-	-	
	Total Non_Agri Area		-	40.04	72.23	-32.19	80.41	Due to plantation coverage RS is greater than Agriculture
IV	**Total Cropped Area**		-	**70.32**	**85.51**	**-15.188**	**21.60**	

TIMELY REPORT OF AGRICULTURAL STATISTICS SPECIAL ENUMERATION						
CROP WISE AREA PARTICULARS						
DISTRICT: BARABANKI	**MANDAL: FAIZABAD**	**VILLAGE: ALIABAD**				
Sl.No	**Crop Name**	**D.E & S (Enumeration Period Kharif)**	**As per APSRAC (Satellite data on 14.10.09)**	**Difference**	**% of % Variation**	**Remarks**
1	PADDY	57.58	55.74	1.84	3.19	
2	ARHAR	4.29	5.84	-1.55	36.14	Mixed cropping of arhar was verified during ground truth
3	SUGARCANE	2.68	4.85	-2.17	81.06	Classified area under sugarcane was verified in post classification (MXL) ground truth
4	OTHER CROP	5.78	19.08	-13.30	230.10	Fragmented and small Patches of miner and mixed crop could not we separable in LISS - III data
	TOTAL	**70.32**	**85.51**	**-15.19**	**21.60**	

Impact of using single date Satellite data minor Agriculture crops could not be separated with higher accuracy. So optimum dates data contributes towards higher accuracy. Classification criteria and accuracy Maximum likely hood classification criteria. More than 95% accuracy was achieved for estimating major Agriculture crops.

Conclusion

This study an effort has been made to estimate the crop area at plot level of Aliabad village using satellite data. The analysis has been carried out for season basis. In this analysis of Khasra map, satellite data and field survey data at plot level of D.E & S have been used. Applying to the classification method on satellite data and integrated approach to each pixel in a girded khasra map obtained a plot level acreage estimation of Aliabad village. Acreage estimation comparison at plot level area with the help of satellite data and conventional data at plot level. The estimated of satellite data analysis have been compared with the available field data and it was found that the result obtained in this study are good.

REFERENCES :

Dubey, R.P., Ajwani, N., Kalubarme, M.H., Sridhar, V.N., Navalgund, R.R., Mahey, R.K., Sidhu, S.S., Jhorar, O.P., Cheema, S.S. and Narang, R.S. 1994. Pre-harvest wheat yield estimation for Punjab, India. Int. J. Remote Sensing, 15: 2137-2144.

Datta, S., Sharma, S.A., Yadav, M., Hooda, R.S., Mothikumar, K.E., Ajai and Manchanda, M.L. 1995. Accuracy assessment in cotton acreage estimation using Indian Remote Sensing satellite data. ISPRS Journal of Photogrammetric Engineering and

Remote Sensing, 46(6) : 21-26.

Dadhwal, V.K., 1999. Remote Sensing applications for agriculture – Retrospective and Perspective. Proc. ISRS National Symp., Remote Sensing applications for Natural Resources: Retrospective and Perspective. Jan. 19 – 21, 1999, Bangalore, pp 11 – 22.

Idso, S.B., Pinter, P.J.Jr. and Renginato, R.J. 1980. Estimation of crop grain yield by remote sensing of crop senescence rates. Remote sensing of Environment, 9: 87-91.

Sahai, B. and Dadhwal, V.K. 1990. Remote Sensing in Agriculture. In: Technology bunding and agrarian prosparity

(eds: J.P. Verma and A. Verma), Malhotra Publishing House, New Delhi, pp. 83-98.

Urmil Verma, Ruhal, D.S., Hooda, R.S., Yadav, M., Khera,A.P., Singh, C.P., Kaluburme, M.H., and Hooda, I.S. 2003. Wheat yield modeling using remote sensing and Agrometeorological data in Haryana. Journal of Indian Society of Agricultural Statistics, 56 (2): 190-198.